FLOYD

THE TOOLING SPECIALISTS FOR PRECISION COMPONENT MACHINING

Operating Instructions

Thread Cutting Heads **ZR 27**

Type: **ZR 27-2** (AR)

WAGNER® WERKZEUGSYSTEME MÜLLER GMBH

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1. Method of operation of the chaser head

This head is of a specially small design and is intended for applications where lack of space prevents the use of the standard Z-type head. This fact must be taken into account when apportioning the work.
The chaser head incorporates four tangential chasers. A series of chaser holders is provided to enable a large operating range and close adaption of the chaser position to the thread pitch to be achieved. In this way, the operating accuracy is suited to the degree of accuracy required by fine threads. Opening and closing of the head is controlled by a carrier mechanism. In its most simple form, the mechanism is actuated by hand, but it can also be modified for automatic operation

1.1. Application

1.1.1. Cutting parallel external threads

All external threads listed in the table of chaser holders can be cut.

1.1.2. Cutting of taper external threads

Taper threads with a taper angle not exceeding 1:16 can be plunge-cut if the thread length including the chamfer is less than the width of the chaser. The stresses imposed on the head are large, and this method can therefore only be employed for fine threads on a continuous basis. Taper threads cut in this way have four slight axial chaser marks which cannot be avoided.

1.1.3. Cutting left-hand threads

Left-hand threads can be produced without difficulty with the same chaser head by rotating the main spindle in the anti-clockwise direction. However, left-hand holders and left-hand chasers will be required.

1.1.4. Skin turning bolts

We can supply skin turning tools whose external design is similar to that of the chaser jaws, except for the absence of thread profiles. The guide teeth are replaced by a wear surface

which prevents the cutting edge from digging into the workpiece. Tools of this type can be used to size bolts at low cutting speeds.
Where higher cutting speeds and greater outputs are desired, the use of a WAGNER® skin turning machine is recommended. The tungsten carbide tools of such a machine result in greatly reduced operating periods.

1.1.5. Use on other machines

A carrier mechanism must be fitted to the head of it is to be used on other machines. This mechanism can be actuated with the carrier [32] which is available on request.

2. Using the chaser head

2.1. Functioning of the component parts of the chaser head

The chaser head comprises four main groups

2.1.1. The die head core

The die head [1] is attached to the main spindle by the four cheese-head screws [10]. The sliding key [9] attached to the die head with the countersunk screw [7] projects into the spindle flange, thus providing the necessary power transmission. The spring-loaded bushes [3]', together with the springs [4], press the holders outwards. This movement is limited by the shoulder studs [5]. The axial movement of the guide ring [8] is limited by the stop pin [17] pressed into the recess of the guide ring by the spring [16]. The cheese-head screw [18] prevents the stop pin from falling out. The spring-loaded ball catch projecting from the sliding key [9] prevents accidental retraction of the die ring when the head is closed.

2.1.2. The die ring

The cam ring [2] and the guide ring [8] are connected by the plates [11] and Allen screws [12]. The unit formed in this way is referred to as the "die ring". As the keyway of the guide ring slides on the key [9], the die ring can only be moved axially in relation to the die head to the extent permitted by the stop pin [17] in conjunction with the recess. The die ring can only be withdrawn after depressing the stop pin [17] with the handle of the taper key [29] inserted through the hole in the guide ring [8]. The cam ring can be rotated against the guide ring with the taper key inserted into the hole [p], after slackening the countersunk screws [13] or the Allen screws [12].

2.1.3. The carrier rind

This controls the axial movement of the die ring. The carrier dogs [26] mounted on the carrier with the two screws [33] engage in the circular groove of the guide ring [8], thus controlling the movement of the die ring even when the head is rotating.

2.1.4. The holders

The chaser holders are swivel-mounted in the die head, their axial position being maintained by the register of the die head. The holders are supported against the cam ring by the sliding blocks [24].

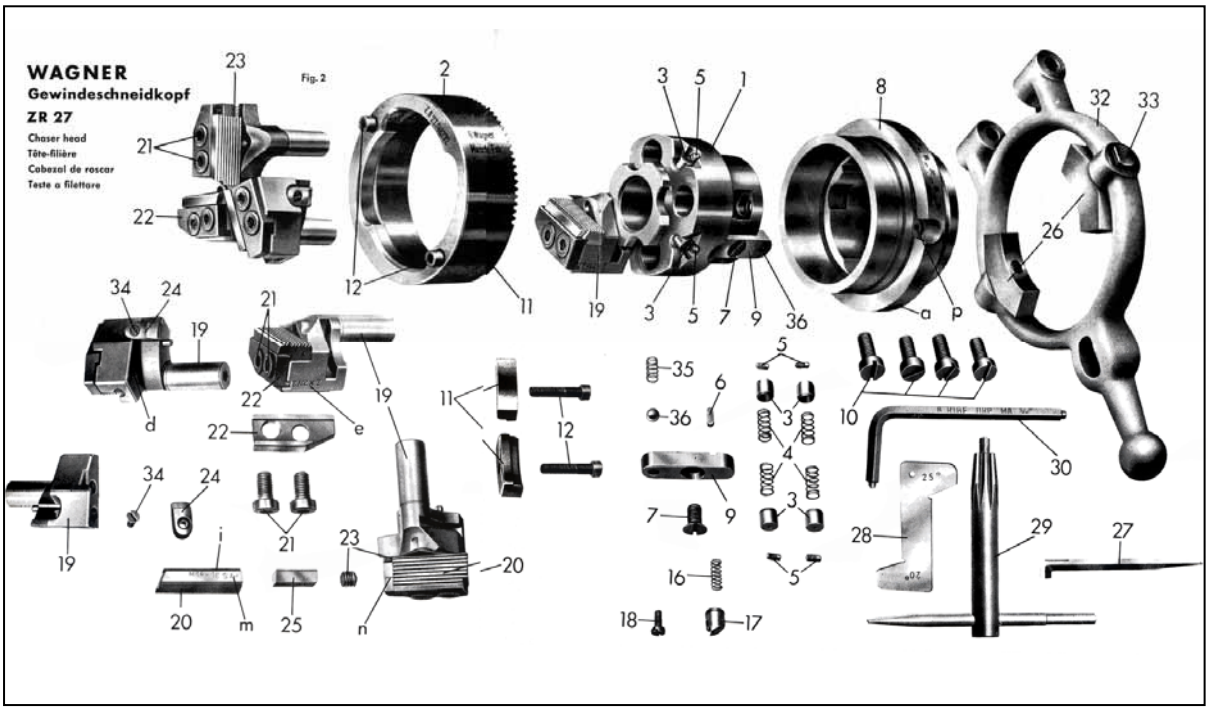


Fig. 1: Chaser Head ZR 27-2

2.2. Description and coding of the chaser holders

The holders can only be used in sets and are not interchangeahle within the various sets. The code number is engraved at the point [d] at the rear of the holder: for example A6 (capital or small letters and figures between 1 and 100).
The code number such as ZR 27/1D will be found at the point [e].
The holder angle is engraved below this inscription. The range of application of the chaser holders can be obtained from the holder tables.

2.3. Changing the chaser holders

To change the chaser holders, the die ring must be pushed back with the aid of the carrier ring beyond the "open" position until the chaser holders swing freely out of the register, ready for withdrawal to the front. The die ring is pushed back by pressing the previously released carrier ring backwards while the stop pin [17] is depressed by inserting the handle of the

taper key [29] through the hole in the guide ring [8]. Standard carriers are provided with a ball handle for this purpose.
Before the holders are replaced, all sliding surfaces must be thoroughly cleaned. The bushes [3] in the die head must also be checked for easy movement.
The chasers [20] are marked with the numbers 1, 2, 3, 4 in position [m]. It is essential to ensure that the chaser holders and chasers are fitted into the die head [1] in the correct sequence 1, 2, 3, 4 (clockwise) for right-hand threads.
For left-hand threads; the sequence 1, 2, 3, 4 follows the anti-clockwise direction.
The die ring can be pushed forward over the sliding blocks [24] until the stop pin [17] re-engages by holding the inserted holders together by hand. In this condition, the die ring can only take up one of two position, the head being closed with the die ring in the fully forward position. The head is open when the die ring is retracted against the stop pin [17]. The tapered section of the sliding blocks [24] must be engaged with the cam ring.

2.4. Changing the chasers

2.4.1. Removing the chaser from the holder.

To remove the chaser [20] from the holder [19], the two clamping screws [21] must be released. The chaser [20] can then be withdrawn from the holder [19] in the direction of the cutting edge. Clamping of the holders is effected most conveniently in the setting device. This should be clamped in a vice or in the vice of the machine slide. The t-headed screw [E21.1] should be released, the holder inserted into the bore of the setting bracket [E21] and swung against the stop [E23]. The holder is then clamped in position by turning the T-headed screw [E21.1]. The clamping screws [21] can then be released.

2.4.2. Setting the dial indicator.

The setting value and the required setting gauge [E25] for the desired thread should be **obtained from the setting table**, on which the diameters of the setting gauge are engraved. The appropriate gauge should then be inserted into the bore of the setting bracket [E21] and locked by means of the clamping screw [E21.1]. Care should be taken to ensure that the setting gauge [E25] is vertically adjusted in such a way that the stylus of the dial indicator rests on the correct step of the setting gauge. The dial indicator [E26] may then be adjusted in the following manners the dial indicator is first inserted into the setting bracket [E21] and axially adjusted until the small pointer [k] of the dial indicator [E26] is accurately set to **zero**.

The clamping screw [E24] should be tightened – but not to such an extent as to interfere with the free movement of the stylus. The dial of the indicator should next be adjusted until the **large pointer** [g] is also set to zero. The setting gauge may then be removed and the setting device is ready for adjustment of the chaser jaws.

2.4.3. Setting the chaser in the holder.

In place of the setting gauge [E25], the carefully cleaned holder [19] is now inserted into the setting bracket [E21]. The clamping plate [22], the clamping screws [21] and the adjusting screw [23] should already have been released.
The chaser [20] should then be inserted into the holder.
The holder is swung against the stop [E23] while the measuring pin cf the dial indicator is retracted. The vertical rrsitlon of the chaser holder and the chaser will he correct if the stylus of the dial gauge rests against the point of the last cutting tooth or moves closely along the side surface of the guide teeth. The chaser must of course never be clamped in a position high enough to cause the stylus to touch the guide teeth.
The holder should be clamped by means of the T-headed screw [E21.1], and the clamping screws [21] should be lightly tightened. The chaser may then be adjusted by means of the setting screw [23] until the dial indicator shows the value quoted for the setting in the tables. (For theoretical setting values, setting above or below centre, see explanations to the setting table – Fig. 4 on page 11).
It is essential to ensure that both the small pointer [k] indicating millimetres, and the large pointer [g] indicating hundredths of one millimetre, correspond to the appropriate setting value. For example, if it is desired to set a value of 1.75, the small hand music be positioned between 1 and 2 and the large hand on 75. The clamping screws [21] may then be tightened, the front clamping screw being tightened first to prevent distortion. It is recommended that the setting screw [23] should subsequently be firmly tightened. If the chaser is worn to such an extent that the clamping plate [22] is in danger of being distorted when the clamping screws [21] are tightened, the packing piece [25] must be inserted. This packing piece has the profile of the chaser dovetail and can be supplied in various lengths.

Having been adjusted, the chaser is now ready for use and the holder can be removed from the setting device.

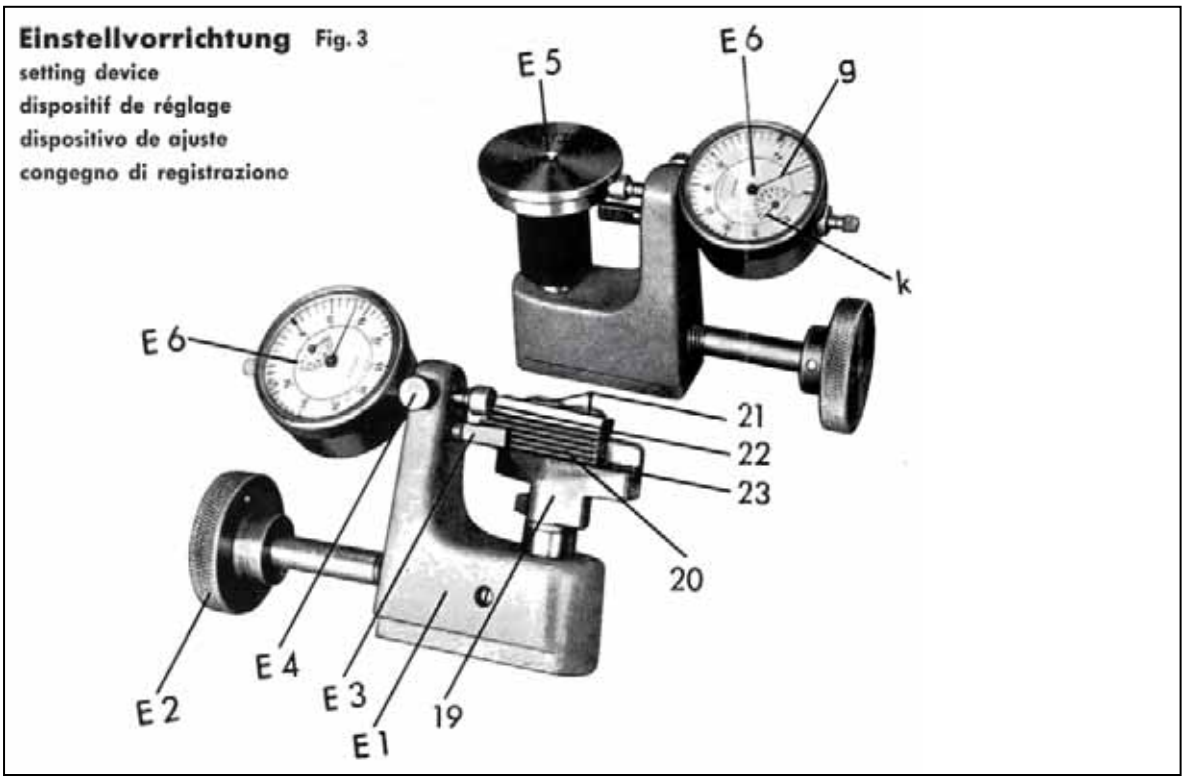


Fig. 2: Setting device

3. The chasers

3.1. Chaser form

The chasers cut tangentially and their main advantage in relation to radial tools is the fact that the front edges of each chaser can be re-ground as often as desired. To clarify the geometrical form of the chaser, it is shown in three views in Fig. 3, and in two vies in Fig. 4, which are so selected that the front edge of the chaser appears as a straight line. Fig. 4 shows how a clearance or relief angle may be produced by changing the setting value (see also chapter 5.1).

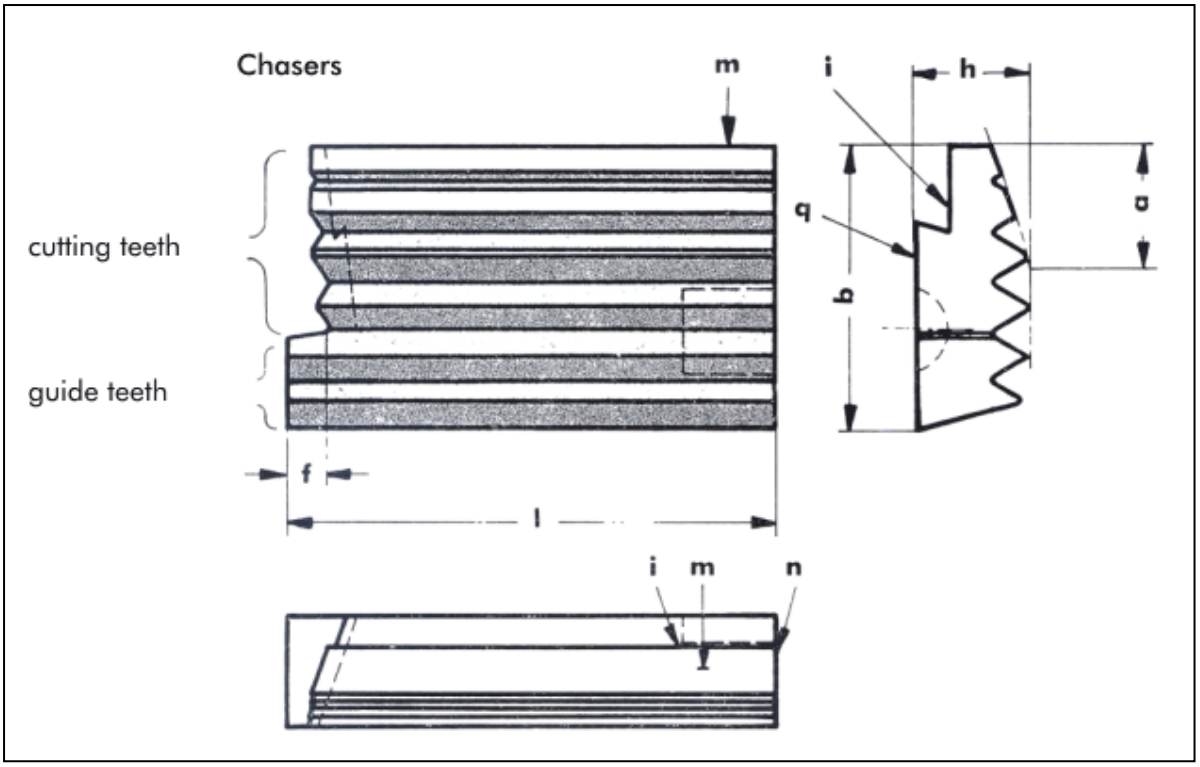


Fig. 3: Chaser form

The teeth directly conversed in the thread cutting process are called *cutting teeth* and the following teeth are known as *guide teeth*. During re-sharpening which should only take place on the front face of the cutting teeth, special care must be taken to ensure that the side face of the guide teeth is not touched, since this face must always coincide with a gap between the successive thread flanks if clear and uniform threads are to be obtained. The first cutting teeth are chamfered to enable the chaser to bite into the material. This is shown in Fig. 3.

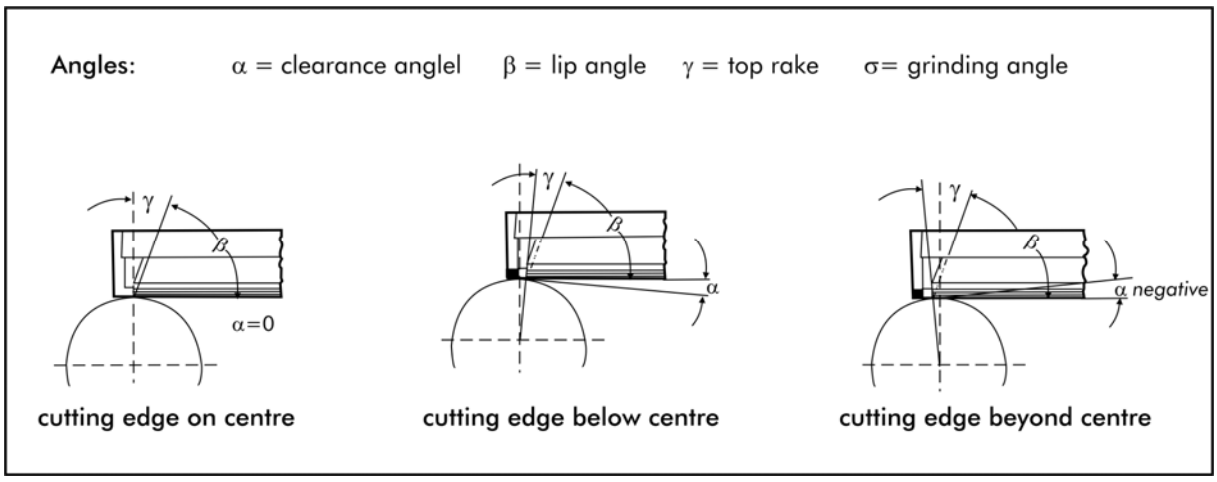


Fig. 4: Adjustment of the chasers

These first teeth represent the *throat*. The first full cutting tooth completes the cutting of the thread. The subsequent guide teeth engage in the thread already cut and provide the desired pitch spacing, thus dispensing with the need for a leadscrew in many cases. The chasers can be supplied with 3 different throats:

A long throat is used for black material and oversize components; the chaser takes the excess material off the workpiece.
A medium throat should be used whenever possible, but its use presupposes that accurately sized material is being threaded.
A short throat should only be used if the medium throat is unsuitable due to its long run-out length, as for instance when threading close to a shoulder. The working life of chasers having a short throat is somewhat less than that of chasers having a medium throat.

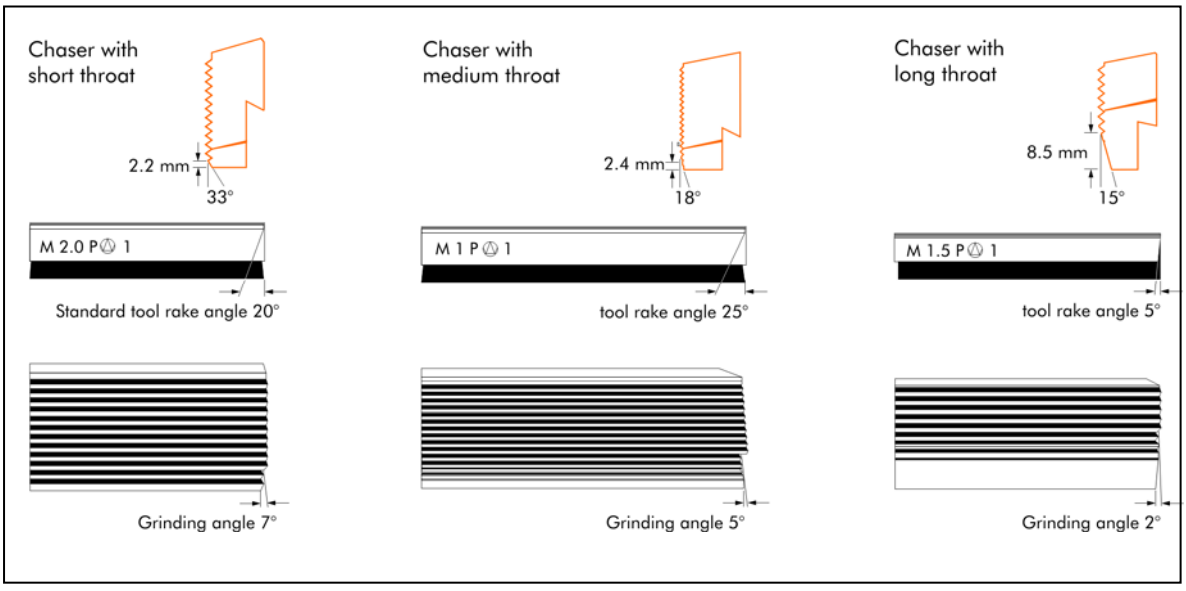


Fig. 5: Chaser throats

Great care must be taken to prevent the side face of the chaser from running against a workpiece having an excessive diameter.

The guide length [f], that is to say the length by which the guide teeth are longer than the first full cutting tooth, should be maintained during successive re-grinds exactly as in the new chaser supplied by our works.
If the guide teeth are too long it may happen that the chasers touch each other, particularly when cutting small thread diameters, thus making it impossible to close the head, If the guide teeth are too short they do not provide sufficient guiding action for cutting the subsequent threads.

3.2. Coding of the chasers

In the same way as the holders, the chasers can also only be used in sets of four. Each set is marked with the same code number. This number is engraved on the rear of the chaser at the point [i]. The chaser number 1 to 4 is to be found on the front surface at the point [m]. These numbers should correspond with the holder numbers 1 to 4 when these are placed in position as already mentioned.
In addition, a standard thread is quoted, such as M 10 metric having a pitch of 1.5 mm. This enables metric threads having a pitch of 1.5 to be cut, for example M 24x1.5; it should be remembered however that the corresponding chaser holder will be required (see holder table).
Chasers marked ½" (½ in. Whitworth thread (B.S.W.) having a pitch of 12 t.p.i.) can be used for cutting all B.S.F. threads having a pitch of 1/12 in., for example ¾ in. diameter x 12 t.p.i.

All chasers other than the V-thread type (for example Acme, knuckle and other special threads) are engraved with the angle ε_{20} at the point [q] (see fig. 3), to enable the grinding angle to be calculated (see chapter 5.6 on page 24).

The markings at point [n] refer to the type of steel used, for example B 32 or B 37. The numbers following the steel code are works reference numbers.

3.3. Chaser grades

The chasers can be supplied in two qualities:
Quality B 32 is the standard grade suitable for maximum continuous output when cutting threads on easily machinable material having a tensile strength of up to 85 kg/mm (55 tons/sq.in.)
Quality B 37 is suitable for material having a high tensile strength or poor machinability. This grade of chaser is only supplied on special request.

3.4. Grinding the chasers

The grinding fixture should be mounted on a grinding machine having an adjustable table at right angles to the grinding wheel. The use of a WAGNER® chaser grinding machine is strongly recommended.
The grinding fixture is either swung sideways into the grinding wheel (using a stop arranged in such a way that the guide teeth are not damaged) or, if a usual tool room grinder is used, the table should be swung at right angles and horizontally to the grinding wheel and spindle.
The chaser to be ground is inserted into the fixture and clamped in position by means of the knurled screw [S4]. The grinding angle σ and the top rake δ should then be set in accordance with the alignment chart on page 25.
Either wet or dry grinding methods may be used. Only slight feed pressure should be applied, irrespective of the method employed.
When grinding dry, the temperature of the chaser should not be allowed to rise beyond that comfortable to touch.
On no account must the chaser be immersed in water after dry grinding !

For wet grinding, a powerful jet of coolant should be directed at the cutting edge. An adequate amount of coolant should be used to protect the chaser from damage.(A rust inhibitor should be added to aqueous coolants.)
Failure to observe the :e precautions may lead to the appearance of hairline cracks which cannot be observed with the naked eye, but which will eventually lead to failure through cracking of the chaser.
Grinding wheels having a grain size of between 46 and 60 and a hardness of K or L are recommended for this purpose.

4. Thread Cutting

4.1. Setting the thread diameter

Setting up of the head is greatly facilitated if a sample thread is available. The following procedure should be adopted: the hexagon nuts of the countersunk screws [13] or the socket screws [12] should be released to enable the cam ring [2] to be adjusted. Adjustment of the cam ring is effected by means of the taper key [29] which is inserted into the aperture [p]. Clockwise rotation of the key will close the head still further. The adjustment is, of course carried out with the head closed, so that the specimen thread held between the chasers can just be rotated.
The trial thread may be cut after re-tightening the countersunk screws [13] of the socket screws [12]. The chaser die head is fitted with a special detent which surely prevents an unintentional displacement of the cam ring into circumferential direction in came of a sudden change of the turning direction. Before the cam ring is adjusted the inserted toothed segment [35] should always be removed by means of the taper key. After adjusting the desired thread diameter of the various delivered toothed segments this segment has to be inserted which is suiting in the best way to the tooth system of the cam ring in the new position.
The use of an Aggra thread gauge, thread micromenter, gauge nut or other means will indicate the need for further adjustment. An adjustment of one scale division in 27 heads is equivalent to a change in diameter of approximately 0.18 mm (0.0070 in.).
If no spezimen thread is available, a pin whose diameter corresponds to that of the core diameter of the thread may be uses for setting up the head.

4.2. Faulty threads and their causes

Faulty threads may be produced for a number of reasons:

I. The correct numerical sequence from 1 to 4 of the chaser holders has not been observed. This results in a completely distorted thread or (if the holders are inserted in the reverse order 4, 3, 2, 1) no thread at all.

II. Chasers from different sets may have been used. In this case the precise amount of offset between the chasers will not be achieved, thus resulting in a faulty thread.

III. The wrong set of chasers may have been inserted. For example it is impossible to produce a parallel thread with chasers for taper threads.

IV. The wrong setting value or grinding angle may have been selected. This may result in the appearance of shallow, thin threads whose roots are goo wide and whose flank angle is too small.

V. Faulty threads may be produced although the mistakes mentioned above were not made, for example if the material requires other setting values or other grinding angles and top rakes than those provided.

The next pages list a number of defects and their remedies.

1. *(Defect)* The thread is not concentric.

(Causes) The four chasers are not adjusted to the same setting value.

The setting value is too small.

The material is not concentric or is sheared off out of true.

The cutting speed is too low. The top rake is too large.

The guide length f is too short.

2. The pitch is faulty.

The pitch angle of the holder is incorrect.

The wrong holder is used.

The wrong chasers are used (for example, a Tr 16x4 thread is being cut with Tr 14x4 chasers. The grinding angle σ is not correct.

The setting value has not been adhered to.

The feed pressure is too high.

The feed pressure is too low or the slide offers too much resistance.

3. Wrong flank angle

The chaser is not squarely mounted in the holder (check the clamping plates and the clamping surface of the chaser)

4. The thread is too shallow

The grinding angle is too small or even negative.

The setting value is too small.

The top rake is too small.

5. The threads are of poor quality, the flank surfaces are rough.

This defect can be due to the formation of a double cutting edge which is often caused by selecting too small a top rake.

The chaser is blunt.
The cutting speed is too high.
The coolant is unsuitable.

6. Continuous score marks on the flanks of the thread.
The offset is wrong.
The chasers are not mounted in the corresponding holders.
The guide teeth do not engage properly with the already cut thread.
The chaser is broken or mount.

7. Chatter marks on the threads.
The setting value is too small. The speed is too high.
The workpiece is clamped with excessive overhang. The top rake is to small for soft material.

8. The thread is eccentric in relation to the centreline of the material.
The material is not clamped concentrically.
The slideways are no longer square to the thread i.e.. to the axis of the head.

9. Multiple threads are generated.
The chasers are not mounted in the correct sequence.
Heavy feed pressure may result in the production of multiple-start threads when cutting fine threads of a comparatively large diameter.
The chaser will then automatically continue to cut these multiple threads.

10. The chaser jaws are broken.
The diameter of the material is too large.
The material is not concentric or is sheared off out of true.
The setting value is too small.
The speed is too low.

4.3. Cooling

Normally, thread cutting should only be carried out with the aid of a supply of coolant.
Water soluble drilling oil can be used, but cutting oil is to be preferred if it is desired to produce clean threads.
This will also considerably increase the working life of the chasers.

5. Tables

5.1. Instructions for the use of the setting tables

To ensure that the chasers are uniformly see in the correct relationship to the workpiece, they are adjusted in a setting device by means of a dial indicator. An accuracy of a few hundredths of a millimetre may be considered adequate. The desired values can be obtained from the setting table to an accuracy of 0.05 mm. The top row lists a large variety of customary threads. Since the setting value depends on the minor thread diameter, this is listed in the first column. The second solemn gives the setting length. This is the dimension between the point of contact of the chaser with the workpiece (assuming that the chaser is accurately set to the centreline of the workpiece) and the centreline of the holder pin. By subtracting half the diameter of the setting gauge from the setting length, the setting values listed in the third and fourth columns are obtained. It is immaterial which of the two steps of the setting gauge is used. In general however it is recommended that the step with the larger diameter be used, as this provides the smaller setting value. This facilitates counting the full millimetres as rotations of the large hand of the dial indicator.

To determine the setting value of a thread not listed in these tables, it is merely necessary to know the minor diameter. This minor diameter should be interpolated in the appropriate position in the first column; the setting length and the setting value will thin be found in adjacent positions in the second and third columns respectively.

The values thus obtained provide a setting in which the cutting edge of the chaser is accurately positioned along the centreline of the workpiece. However, this setting does not always result in the production of good threads.

It will often be necessary to select a slightly larger value (see Fig. 4 on page 11).

When cutting threads in soft material it will be necessary to place the cutting edge beyond the centreline of the workpiece. In other words, the setting value must be increased if the threads produced with the normal setting value are not fully concentric. It is recommended that the value be initially increased by only 1%. Further adjustment of the chaser may be required if this does not produce the desired results.

Depending on the type of thread to be cut end material used, it may be necessary to increase the value by as much as 3 % of the diameter. In affecting these adjustments it must be remembered that the cutting temperature is always increased if the chaser acts at a point beyond the centreline of the workpiece. The setting value should therefore not be increased more than absolutely necessary to produce the desired clean threads.

Minor Ø	Setting length	Setting value gauge 48 Ø	Metric threads DIN 13	Metric fine threads DIN 13		BSW threads DIN 11	BSF threads	BSP threads	American National Threads					DIN FAFA 4	Conduit threads DIN 40430
									ANPT	NC	UNC	NF -	UNF		
2,00	26,05	2,05	6 - 7	M4-6 x 0,6 M5-7 x 0,75 M7-1		1/4" . 5/16"	W 1/4"x1/26"			No 12-24 1/4-20 5/16-18	No 8-32		No 8-36 No 10-32 No 12-29 1/4 - 28	FG 6,350	
6,24															
8,73	26,00	2,00	8 - 10	M7-9 x 0,5 M8-9 x 1 .	M8-9 x 0,75 M8-10 x 1,25	3/8"	W 5/16"x1/22" W 3/8"x1/20"	R 1/8"		3/8-16		5/16-24 3/8-24		FG 7,937 FG 9,525	
9,58	25,95	1,95	11	M10 x 0,5 M10 x 1	M10 x 0,75 M11 x 1,25	7/16"	W 7/16"x1/18"		1/8-27	7/16-14		7/16-20			
10,44	25,90	1,90	12	M11 x 0,5 M11 x 0,75	M12 x 1,25 M11 x 4 M12 x 1,5	1/2"				1/2-13 1/2-12					
11,20	25,85	1,85		M12 x 0,75 M12 x 1	M13 x 1,5		W 1/2"x1/16"					1/2-20			
11,90	25,80	1,80	14	M12 x 0,5	M13 x 1 M13 x 1,25	9/16"		R 1/4"	1/4-18	9/16-12					Pg 7
12,51	25,75	1,75		M13 x 0,5 M13 x 0,75	M14 x 1,25 M14 x 1,5		W 9/16"x1/16"								
13,10	25,70	1,70		M14 x 0,75 M14 x 1	M15 x 1,5	5/8"				5/8-11		9/16-18		FG 14,288	
13,64	25,65	1,65	16	M14 x 0,5 M15 x 1,25			W 5/8"x1/14"								
14,16	25,60	1,60		M15 x 0,75 M15 x 1	M16 x 1,5							5/8-18			Pg 9
14,65	25,55	1,55		M15 x 0,5 M16 x 1,25											
15,13	25,50	1,50	18	M16 x 0,75 M16 x 1	M17 x 1,5		W 3/4"x1/12"	R 3/8"	3/8-18						
15,57	25,45	1,45		M16 x 0,5 M17 x 1,25	M18 x 2										
16,01	25,40	1,40		M17 x 1		3/4"				3/4-10					
16,42	25,35	1,35		M17 x 0,5 M17 x 0,75	M18 x 1,25 M19 x 1,5										
16,82	25,30	1,30	20	M18 x 1 M19 x 2			W13/16"x1/12"								
17,20	25,25	1,25		M18 x 0,75 M19 x 1,5								3/4 - 16			
17,58	25,20	1,20		M18 x 0,5 M19 x 1,25	M20 x 2										Pg 11
17,95	25,15	1,15		M19 x 1											
18,30	25,10	1,10		M19 x 0,75 M20 x 1,5											
18,64	25,05	1,05		M19 x 0,5 M20 x 1,25	M21 x 2	7/8"		R 1/2"	1/2 - 14	7/8 - 9					
18,99	25,00	1,00	22	M20 x 1											
19,31	24,95	0,95		M20 x 0,75 M21 x 1,5			W 7/8"x1/11"								Pg 13,5

Minor Ø	Setting length	Setting value gauge 48 Ø	Setting value gauge 42 Ø	Metric threads DIN 13	Metric fine threads DIN 13		BSW threads DIN 11	BSF threads	BSP threads	American National Threads					Trapezoid threads DIN 103	Conduit threads DIN 40430
										ANPT	NC	UNC	NF -	UNF		
19,31	24,90	0,90			M20 x 0,5 M21 x 1,25	M22 x 2										
19,64	24,85	0,85			M21 x 1,25											
19,96	24,80	0,80		24	M21 x 0,75 M22 x 1,5								7/8 - 14			
20,26	24,75	0,75			M21 x 0,5 M22 x 1,25	M 23 x 2										
20,56	24,70	0,70			M22 x 1			W15/16"x1/11"	R 5/8"							
20,86	24,65	0,65			M22 x 0,75 M23 x 1,5											
21,15	24,60	0,60			M22 x 0,5 M23 x 1,25	M24 x 2	1"				1 - 8					Pg 16
21,43	24,55	0,55			M23 x 1											
21,71	24,50	0,50														
21,99	24,45	0,45			M23 x 0,75 M24 x 1,5			W1"x1/10"								
22,25	24,40	0,40			M23 x 0,5 M24 x 1,25	M25 x 2										
22,52	24,35	0,35			M24 x 1											
22,78	24,30	0,30			M24 x 0,75								1 - 12			
23,04	24,25	0,25			M25 x 1,5									1 - 14		
23,29	24,20	0,20			M24 x 0,5 M25 x 1,25	M26 x 2										
23,54	24,15	0,15			M25 x 1,25											
23,79	24,10	0,10			M25 x 0,75 M26 x 1,5					3/4 - 14						
24,03	24,05	0,05							R 3/4"						FG 25,400	
24,27	24,00	0,00			M25 x 0,5 M26 x 1,25	M27 x 2										
24,50	23,95		2,95		M26 x 1											
24,74	23,90		2,90													
24,97	23,85		2,85		M26 x 0,5 M26 x 0,75	M27 x 1,5										
25,19	23,80		2,80		M26 x 0,5 M27 x 1,25											
25,41																

Minor Ø	Setting length	Setting values gauge 42 Ø	Metric fine threads DIN 13	BSF threads	American National Threads NF
25,41	23,75	2,75	M28 x 2		
25,63	23,70	2,70	M27 x 1		
25,86	23,65	2,65	M27 x 0,75 M28 x 1,5		
26,07	23,60	2,60			
26,28	23,55	2,55	M27 x 0,5 M28 x 1,25 M29 x 2		
26,49	23,50	2,50	M28 x 1		
26,70	23,45	2,45			
26,91	23,40	2,40	M28 x 0,75 M29 x 1,5		
27,11	23,35	2,35			
27,31	23,30	2,30	M28 x 0,5 M29 x 1,25 M30 x 2		
27,51	23,25	2,25	M29 x 1		
27,70	23,20	2,20			
27,90	23,15	2,15	M29 x 0,75 M30 x 1,5		
28,09	23,10	2,10			
28,28	23,05	2,05	M29 x 0,5 M30 x 1,25		
28,47	23,00	2,00			
28,66	22,95	1,95	M30 x 1		
28,85	22,90	1,90	M30 x 0,75		
29,03	22,85	1,85	M31 x 1,5		
29,21	22,80	1,80	M30 x 0,5		
29,39	22,75	1,75			
29,57	22,70	1,70			
29,75	22,65	1,65			
29,93					

Minor Ø	Setting length	Setting values gauge 42	Metric fine threads DIN 13	BSF threads
29,93	22,60	1,60	M32 x 1,5	
30,10	22,55	1,55		
30,27	22,50	1,50		
30,44	22,45	1,45		
30,61	22,40	1,40		
60,78	22,35	1,35		
30,95	22,30	1,30	M33 x 1,5	
31,11	22,25	1,25		
31,27	22,20	1,20		
31,43	22,15	1,15		
31,59	22,10	1,10		
31,76	22,05	1,05		
31,92	22,00	1,00	M34 x 1,5	
32,07	21,95	0,95		
32,23	21,90	0,90		
32,38	21,85	0,85		
32,53	21,80	0,80		
32,68	21,75	0,75		
32,84	21,70	0,70		
32,99	21,65	0,65	M35 x 1,5	
33,14	21,60	0,60		
33,28	21,55	0,55		
33,43	21,50	0,50		
33,57				

Setting length	Setting values gauge 42 Ø	Setting values gauge 36 Ø	Metric fine threads DIN 13	BSP threads	NF
21,45	0,45				
21,40	0,40				
21,35	0,35				
21,30	0,30		M36 x 1,5		
21,25	0,25				
21,20	0,20				
21,15	0,15				
21,10	0,10				
21,05	0,05				
21,00	0,00				
20,95		2,95	M37 x 1,5		
20,90		2,90			
20,85		2,85			
20,80		2,80			
20,75		2,75			
20,70		2,70			
20,65		2,65			
20,60		2,60	M38 x 1,5		
20,55		2,55			
20,50		2,50			
20,45		2,45			
20,40		2,40			
20,35		2,35			

Minor Ø	Setting length	Setting values gauge 36 Ø	Metric fine threads DIN 13	BSP threads
36,66	20,30	2,30		
36,79	20,25	2,25		
36,92	20,20	2,20		
37,04	20,15	2,15	M39 x 1,5	
37,16	20,10	2,10		
37,28	20,05	2,05		
37,4	20,00	2,00		
37,52	19,95	1,95		
37,64	19,90	1,90		
37,75	19,85	1,85		
37,87	19,80	1,80		
37,99	19,75	1,75	M40 x 1,5	
38,10	19,70	1,70		
38,22	19,65	1,65		
38,33	19,60	1,60		
38,44	19,55	1,55		
38,56	19,50	1,50		
38,67	19,45	1,45		
38,78	19,40	1,40		
38,9	19,35	1,35		
39,01	19,30	1,30	M41 x 1,5	
39,12	19,25	1,25		
39,23	19,20	1,20		
39,33				

Minor Ø	Setting length	Setting values gauge 36 Ø	Metric fine threads DIN 13	BSP threads
39,33	19,15	1,15		
39,44	19,10	1,10		
39,55	19,05	1,05		
39,66	19,00	1,00		
39,76	18,95	0,95		
39,87	18,90	0,90		
39,98	18,85	0,85	M42 x 1,5	
40,08	18,80	0,80		
40,18	18,75	0,75		
40,29	18,70	0,70		
40,39	18,65	0,65		
40,49	18,60	0,60		
40,59	18,55	0,55		
40,70	18,50	0,50		
40,80	18,45	0,45		
40,90	18,40	0,40		
41,00	18,35	0,35		
41,10	18,30	0,30		
41,19	18,25	0,25		
41,29	18,20	0,20		
41,39	18,15	0,15		
41,48	18,10	0,10		
41,58	18,05	0,05		
41,68				

5.3. Instructions for using the table of chaser holders

The table of chaser holders enables the user to select the appropriate holder in accordance with his requirements. This avoids time-consuming enquiries.

The head of the table contains a large number of standard threads which include German, English and American threads. American threads appear under the description ANPT.
The first column lists all normal chaser holders which can be supplied for any particular chaser head.
The second column lists the holder angle, then follows a column giving the dimensions of the chaser. *In this last column* the first two figures refer to the cross-section of the chaser and the last figure to the length of a new chaser. Re-sharpening will of course reduce this length.
The minimum and maximum core diameters which can be cut with the particular holder are quoted in the *fourth column*.
The quality or grading of the thread is divided into three classes in accordance with DIN (German Standards), that is to say, close, medium and coarse tolerance.
To cut a close-tolerance thread it will be necessary to select the correct relationship between the holder angle and the helix angle of the thread. In other words, it is not possible to cut a close tolerance thread using a holder whose diameter range corresponds only to the minor diameter. In the table, therefore, all threads coming within the close-tolerance range are marked by being placed in brackets. The first two groups of holders refer to a fairly large range and naturally incorporate only a few threads within the close-tolerance range. The other holders are intended mainly for close-tolerance threads, but it is also possible to cut come additional threads within the medium-tolerance range.
Metric fine threads are indicated by a figure which appears in the form of a fraction under the main figure, which indicates the pitch of the thread in mm. The figures corresponding to the numerator of such a fraction contain one or more numbers which refer to the external diameter of the thread.
The thread ranges listed in the chaser holder tables cannot be covered in all cases because, as already mentioned, the head must not be overstressed. Continuous threading of high-tensile steel ca. 800 N/mm^2 and more and other hard materials must therefore be limited to the following threads: **M 24 metric** with size 27 heads.

Owing to the compact desigr.of the head, the thread lengths of the larger of the diameters quoted are also limited. For full details, see footnotes in the chaser holder tables.

5.4. Table of chaser holders for types ZA/ ZR 27 Die Heads

Chaser holder			Cutting range	Metric	Metric fine threads	Whitworth-	B S F	Whitworth-	American National Threads			Steel conduit
Designation Product-No.	Holder angle in °	Dimension of chasers	core diameter in mm	threads DIN 13	DIN 246, 247 516-519	threads DIN 11	threads	pipe threads DIN 259/DIN 2999	NPT NPS	NC UNC	NF UNF	pipe threads DIN 40430
ZR27/1D 702004	4,08°	22x10x40	3,1 - 13,6	M4,5-6 M7-14		1/4", 5/16" 3/8" 7/16", 1/2"				No 12-24 5/16-18 3/8-16 7/16-14	No 8-36 No 10-32 No 12-28	
ZR27/20D 732997	2,41°	22x10x40	7 - 17,3		M8-9x0,75 M10-11x1 M12-14x1,25 M14-18x1,5		W11/16"x1/14"	R1/8" R1/4" R3/8"	1/8-27 1/4-18 3/8-18		1/2-20 9/16-18 5/8-18 3/4-16	Pg 7-9 Pg 11
ZR27/21D 739036	2°	22x10x40	16 - 26,1		M18-28x1,5 M24-28x2			R1/2" R5/8" R3/4"	1/2-14 3/4-14		7/8-14 1-14 1.1/8-12	Pg 11 Pg 13,5 Pg 16-21
ZR27/63D 702006	3,60°	22x10x40	3,1 - 13,6	M7-14 M18		9/16" 5/8"	W1/4"x1/28" W5/16"x1/22"			1/2-13 9/16-12 5/8-11	1/4-28	
ZR27/65D 702013	3,08°	22x10x40	13 - 22,6	M16-24	M17-18x2	3/4" 7/8" 1"	W5/8"x1/14" W3/4"x1/12"			3/4-10 7/8-9 1-8		
ZR27/69D 702007	3,08°	22x10x40	3,1 - 13,6	M11 M16	M6x0,75 M8-9x1 M10-11x1,25 M12-13x1,5		W3/8"x1/20" W7/16"x1/18" W1/2"x1/16" W5/16"x1/16" W5/8"x1/14"				5/16-24 3/8-24 7/16-20	
ZR27/72D 735750	2,20°	22x10x40	9,0 - 19,1		M10x0,75 M11-14x1 M13-17x1,25 M16-20x1,5 M20x2			R1/8"-1/4" R3/8"-1/2"	1/8-27 1/4-18 3/8-18		5/8-18 3/4-16	Pg 7-9 Pg 11-13,5
ZR27/73D 732873	1,75°	22x10x40	16 - 26,1		M18-20x1 M19-24x1,25 M20-29x1,5 M28x2			R5/8"-3/4"	1/2-14 3/4-14		1-14	Pg 16-21
ZR27/76D 732875	1,5°	22x7x32	26-1 - 35,1		M28-36x1 M28-37x1,5 M30-37x2			R1"	1-11,5			

ZA, ZB 27 over 18 up to 27 mm diameter max. length 65 mm
over 27 mm diameter max. length 28 mm

ZR 27 over 27 mm diameter max. length 28 mm
for conical threads max. length 17 mm

5.5. Selecting the top rake

The top rake δ for steel normally amounts to 20° and chasers are normally supplied with this angle. For brass and bronze this angle should be reduced to some angle between 8 and 12° (sometimes even smaller). Mild steel, aluminium and copper require a top rake of up to 30 ° The use of a relief (chip breaker) groove is recommended when cutting threads in aluminium and copper.

5.6. Calculating the grinding angle

To ensure reliable operations the chaser should be ground in such a way that its cutting edge coincides with the centreline of the workpiece. In chasers not equipped with guide teeth (for cutting pipe threads) the grinding angle should be equal to the holder angle. The throat angle compels the grinding angle to be larger than the holder angle, thus: grinding ankle = holder ankle + supplementary ankle. The size of the supplementary angle depends on certain variables and in particular on the top rake δ. For V-threads; all variable effects with the exception of the top rake have been approximately combined in the constant value ε_{20} (see table in Fig. 6 on page 25).
The description ε_{20} refers to the supplementary angle ε obtained when the top rake δ equals 20 °.

Example 1:
It is desired to grind an chaser medium throat, top rake of 20°. The holder angle will be 3.8 °, the supplementary angle referred to a top rake of 20 ° amounts to 3.5 °. The grinding angle will therefore be equal to 3.8 + 3.5 = 7.3°. The alignment chart should be used if a top rake other than 20 ° is to be used.

Example 2:
It is desired to cut B.S.F. thread having a top rake of 15 ° and a short throat. The angle ε_{20} amounts to 6.8 ° in accordance with the table for a short throat. This angle is marked on the scale "Supplementary angles for 20 ° top rake".
In drawing a connecting line on the inclined top rake reference through the point 15°, the figure 4.9 ° will be obtained in the scale giving the supplementary angle. The holder angle amounts to 3.8 °, the grinding angle will therefore be equal to 3.8 + 4.9°.
For special threads the expression ε_{20} can no longer be given as a constant. In such cases **the angle ε_{20} is therefore engraved on the underside of chaser No. 1 of each set.**

The value σ thus calculated ensures that the cutting edge is parallel to the centreline of the workpíece. It is however possible that in certain materials this is not entirely desirable, for instance when cutting stainless steels (VA steels). It may then be advisable to reduce the grinding angle σ considerably, and in certain circumstances it may even be necessary to have a negative grinding angle.

Chasers supplied by our works are ground for normal metric or Whitworth threads. For fine threads the chaser must be ground in accordance with these instructions.

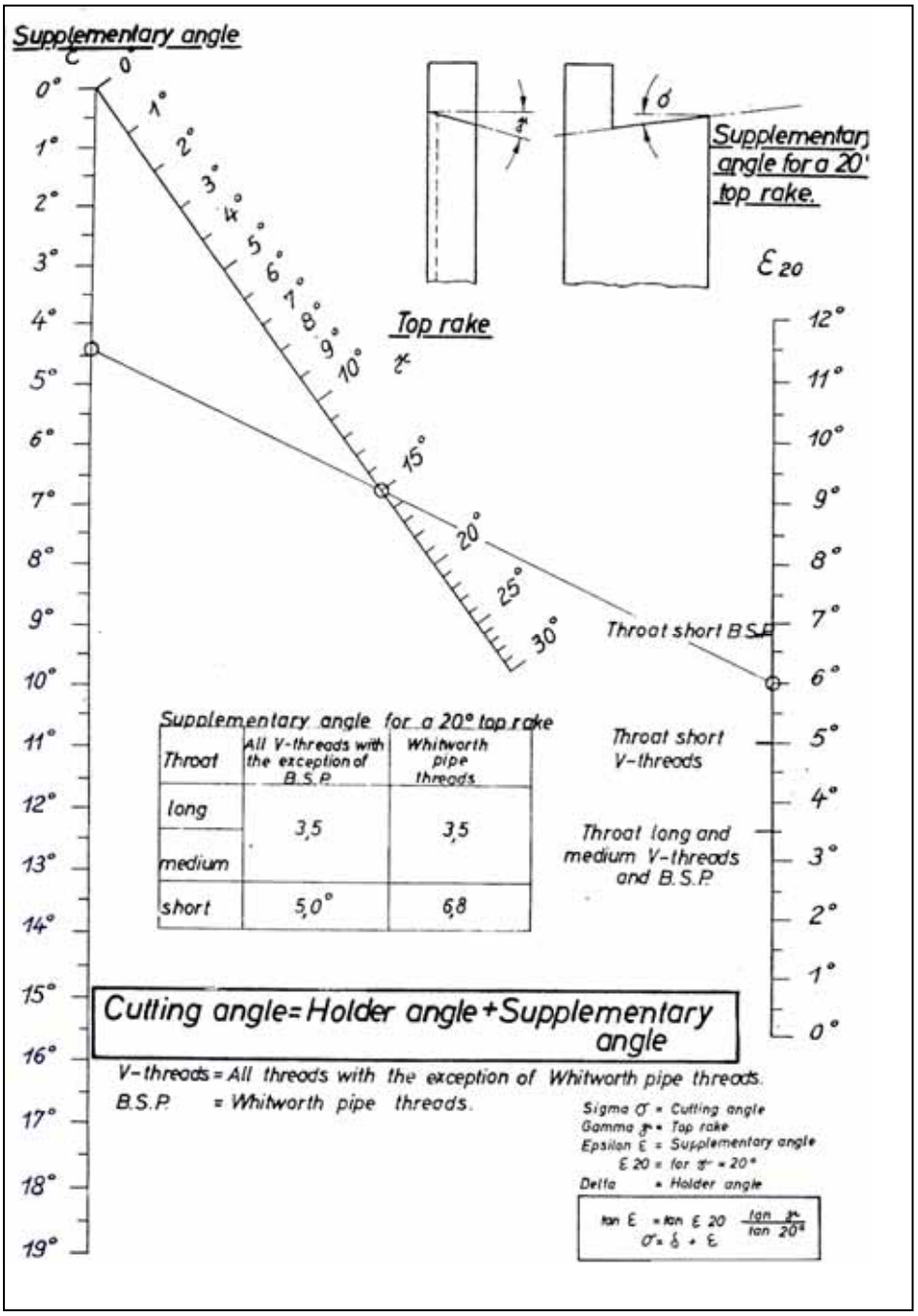

Supplementary angle
Supplementary angle for a 20° top rake.
Top rake
Throat short B.S.P.
Throat short V-threads
Throat long and medium V-threads and B.S.P.
Supplementary angle for a 20° top rake
Throat | All V-threads with the exception of B.S.P. | Whitworth pipe threads
long | 3,5 | 3,5
medium
short | 5,0° | 6,8
Cutting angle = Holder angle + Supplementary angle
V-threads = All threads with the exception of Whitworth pipe threads.
B.S.P. = Whitworth pipe threads.
Sigma σ = Cutting angle
Gamma γ = Top rake
Epsilon ε = Supplementary angle
ε 20 = for γ = 20°
Delta δ = Holder angle
tan ε = tan ε 20 · tan γ / tan 20°
σ = δ + ε

Fig. 6: Alignment chart for calculating the grinding angle

5.7. Calculating the cutting speed

The normal practice of obtaining accurate data concerning cutting speeds and tools used when turning various materials is well known. It is not possible to obtain such data for thread cutting, since in this case the cutting speed depends on many variables including the workpiece, diameter, thread, depth, pitch, setting value, top rake, grinding angle, and lastly on the required quality of surface finish on the thread flanks. The table given below therefore provides merely an approximate guide which will facilitate the selection of the correct cutting speed for any given application.

The first column in this table contains only a few materials. Materials not mentioned should be interpolated as appropriate between two of the materials quoted. *The second column* quotes cutting speeds when cutting V-threads. It should be noted that the loser cutting speed always refers to the larger diameter while the higher cutting speed refers to the smaller diameter.

The following approximate rule should be adopted for cutting fine threads: A thread of the same pitch as the desired fine thread should be found from the standard range of threads. The corresponding cutting speed should then be selected for the fine thread.

Material	**Cutting Speed**	
	m/ min	**ft/ min**
Free-cutting steel	7 – 12	22 – 40
C 35	5 – 8	16 – 26
C 60	3 – 6	10 – 20
VCMo 135	2 – 4	6 – 13
VA steels	1.5 – 3	5 – 10
Brass and Bronze	15 and more	50 and more

Threads for pipes and pipe fittings may be cut an a great variety of material. The cutting speeds for these range from 10 to 20 m/min (32 - 65 ft/min).

The correct cutting speed must be found by trial and error from case to case.

Instructions for using the thread cutting speed alignment chart

The left-hand scale “d” contains major diameters in millimetres and inches as well as the major diameters for Whitworth pipe threads (B.S.P.) which will be found further to the right. The centre scale refers to the speed (it is recommended to mark the actual speeds provided on the machine in the alignment chart, while in the right-hand scale will be found the required cutting speed. A straight line drawn through the desired diameter and the desired speed will

therefore provide the corresponding cutting speed; the example in the alignment chart illustrates this d = 20 mm n = 64/ min. v = 4 m/min.

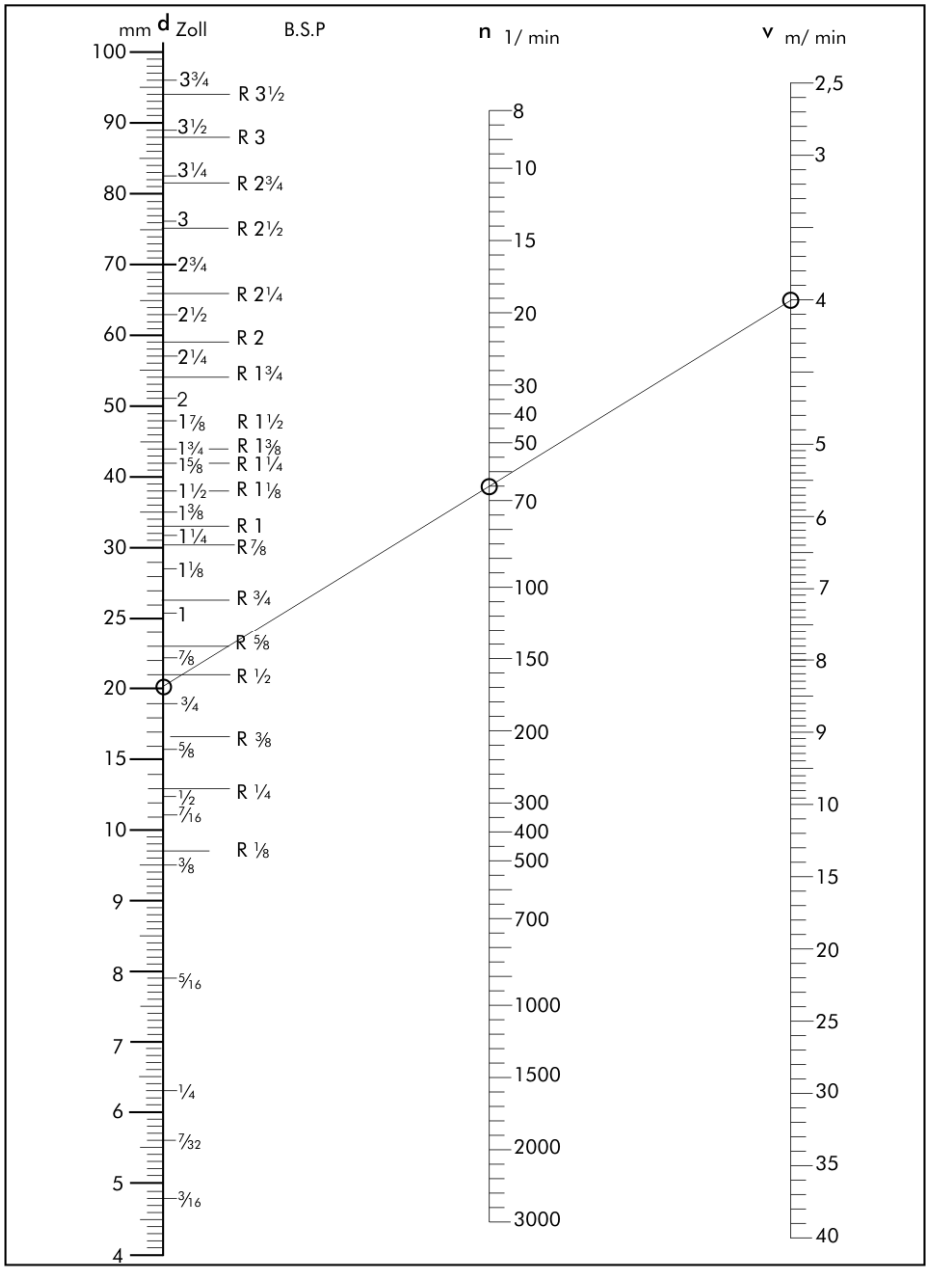


Fig. 7: Alignment chart for the determination of the cutting speed

$$v = \frac{\pi \cdot d \cdot n}{1000}$$

d = Major diameter mm in B.S.P.

n = rev/min

v = Cutting speed [m/min]

5.8. Calculating the helix angle

Normally, it is not necessary to know the helix angle of the thread to be cut, since the threads are listed in the chaser holder table in such a way that the corresponding holders can be read off directly.
In special cases, however, not listed in the chaser holder table, the helix angle can be easily calculated with the aid of the alignment chart on page 29. It is essential to use the effective rather than the major diameter o' the thread concerned in the calculation. That is to say:

$$dm = \frac{da + dk}{2}$$

dm = effective diameter
da = major diameter
dk = minor diameter

The helix ankle is calculated in accordance with the expression:

$$\tan \delta = \frac{P}{\Pi \cdot d}$$

P = pitch of thread in mm
d = effective diameter.

The left-hand scale of the alignment chart on page 29 represents values of "P", the centre scale represents values of "d", and the right-hand scale represents the .pitch angle δ. The latter value is calibrated in decimal form on the left-hand side of the scale and in degrees and minutes of arc on the right-hand side of the scale.
The pitch of the desired thread is found on the “P”-scale and the effective diameter is found on the "d"-scale. The straight line connecting these points will pass through the δ -scale and give the desired helix angle.

In the example shown the helix angle for an M16 metric thread is calculated. The effective diameter is equal to:

$$dm = \frac{da + dk}{2} = \frac{16 + 13.402}{2} = 14.701$$

The flank diameter is also equal to 14.701. The pitch “P” is equal to 2 mm. The straight line "P-d" provides the helix angle δ of 2.49° or 2° 29' .

In most cases the effective diameter is almost identical with the flank diameter; the later may therefore be used in these calculations.

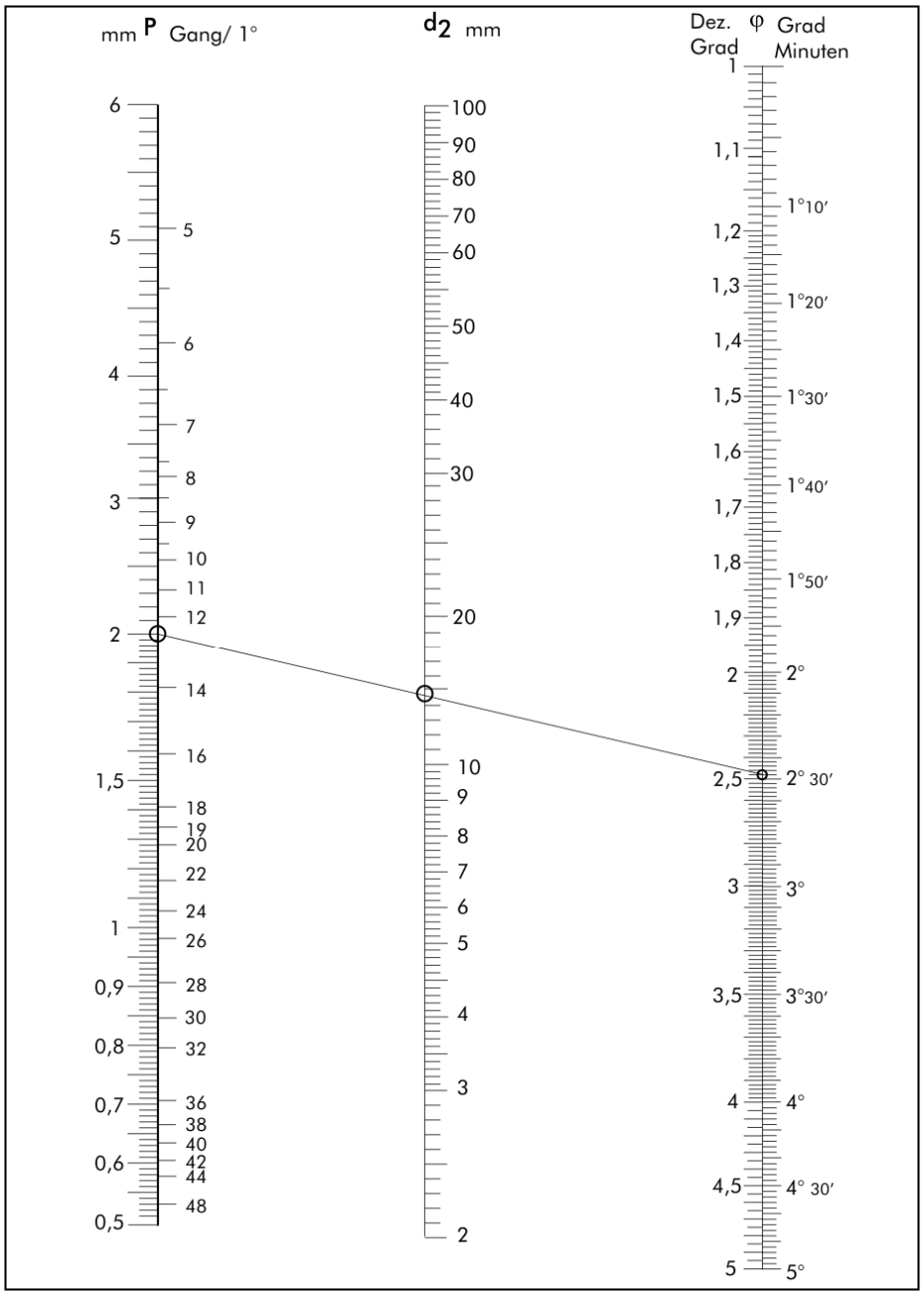


Fig. 8: Alignment chart for the determination of the helix angle

6. Spare Parts and accessories

6.1. Parts of chaser head ZR 27-2

(Product No. 738 000 00)

1	1	738957	Head body
2	1	724550	Excentric ring
3	4	705165	Spring-loaded cylinder
4	4	03310047	Compression spring 0.9x6.6x17.0
5	4	02030055	Shoulder stud M4x8 DIN 427
6	1	02160002	Key DIN 6885
7	1	02020207	Countersunk screw M8x15 DIN 63-5.8
8	1	724552	Guide ring
9	1	705255	Sliding key
10	4	02016104	Cheese head screw M6x16
11	2	705166	Key plate
12	2	02015060	Socket screw M5x30 DIN 912-12.9
16	1	03310039	Compression spring 0.8x5.2x15.5
17	1	705164	Stop pin
18	1	02016002	Cheese head screw M4x10
35	1	03310044	Compression spring 0.9x6.1x14.0
36	1	02460123	Steel ball DIN 5401
37	1	73800900	Cover ZR27-2 10x12,7
38	1	02016054	Cheese head screw M5x16 DIN6912 8.8
39	1	02046155	Threaded pin M6x12 DIN 914- 12.9
			Accessories Head
27	1	03697201	Allen key with screw driver
29	1	731040	Taper key
19	4		Chaser holder
21	8	03011702	Clamping screw
22	4		Clamping plate (according to type of holder)

23	4		Adjusting screw (according to type of holder)
24	4	701998	Sliding pad
25	4		Packing (according to type of holder)
30	1	02677006	Allen key 6 DIN 911
34	4	02020056	Countersunk screw M4x10 DIN 63

Carrier ring Product No. 705253

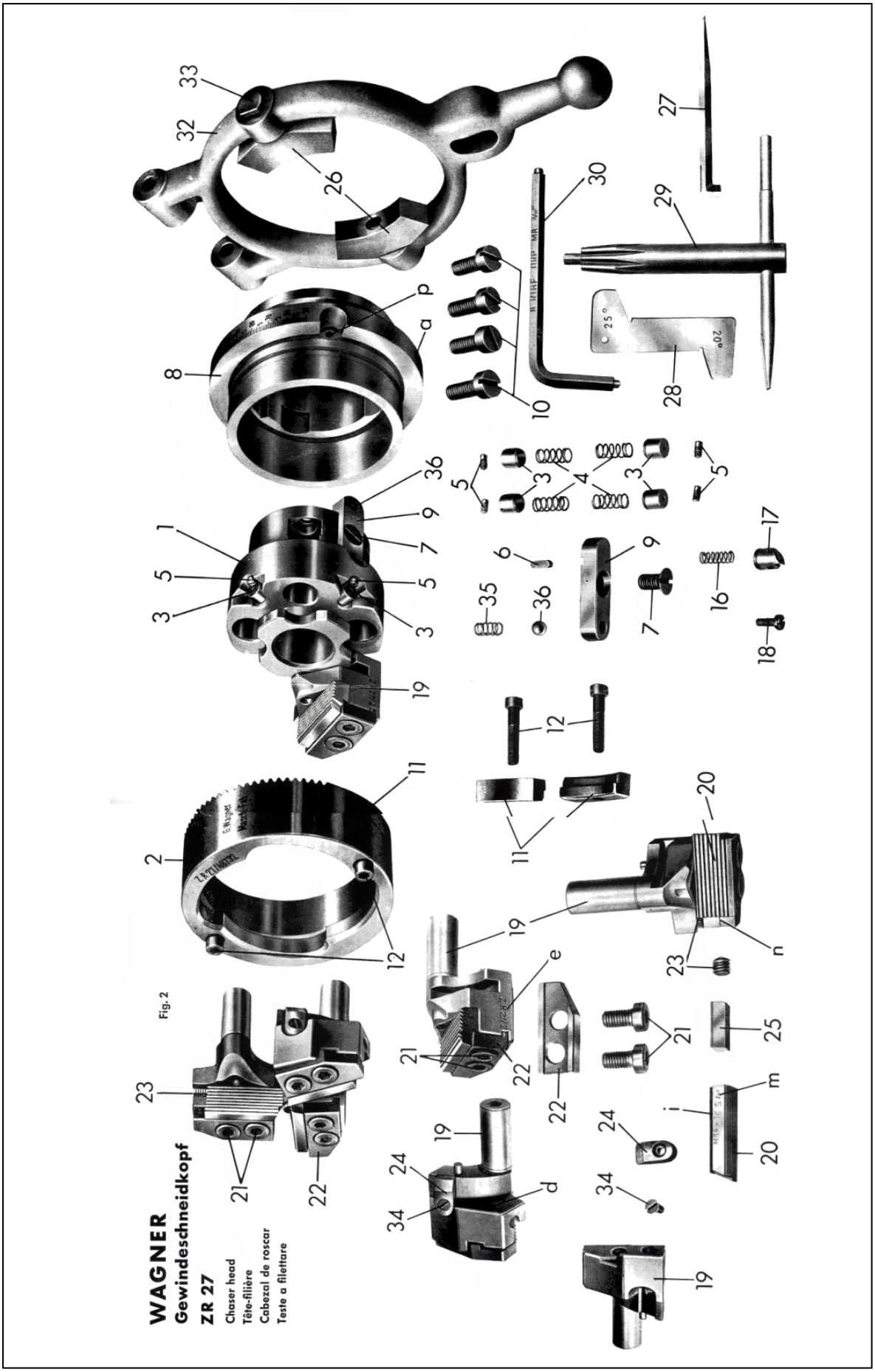
26	2	705249	Carrier jaw 117/80x14
32	1	705248	Carrier ring
33	2	705250	Carrier screw M10x1 RD14x36

Setting device Product No. 733970

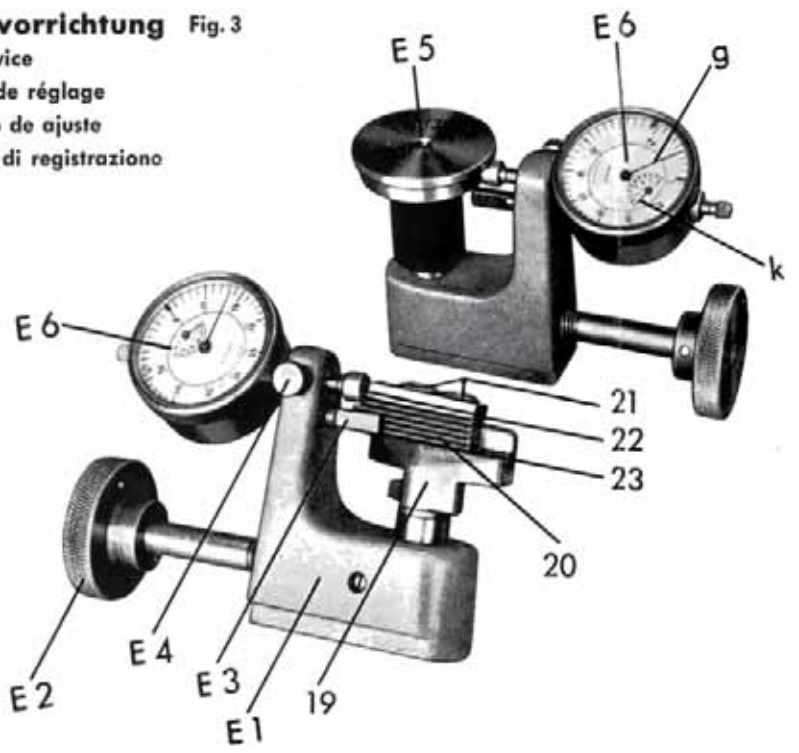
E21	1	733971	Setting bracket
E21.1	1	02035508	T-headed screw
E21.2	1	03240186	pressure pad
E22	1	733972	Dial gauge holder
E23	1	705263	Stop
E24	1	02035416	Clamping screw
E25	1	705260	Setting gauge
E26	1	06525003	Dial gauge

Grinding Fixture

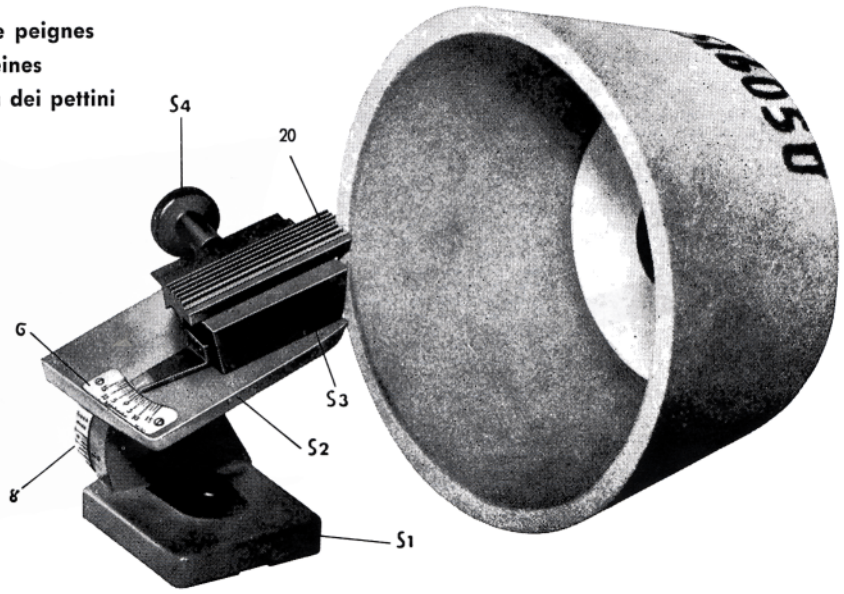
S1			Lower section
S2			Center section
S3			Upper section
S4			Knurled screw


WAGNER
Gewindeschneidkopf
ZR 27
Chaser head
Tête-filière
Cabezal de roscar
Teste a filettare
Fig. 2

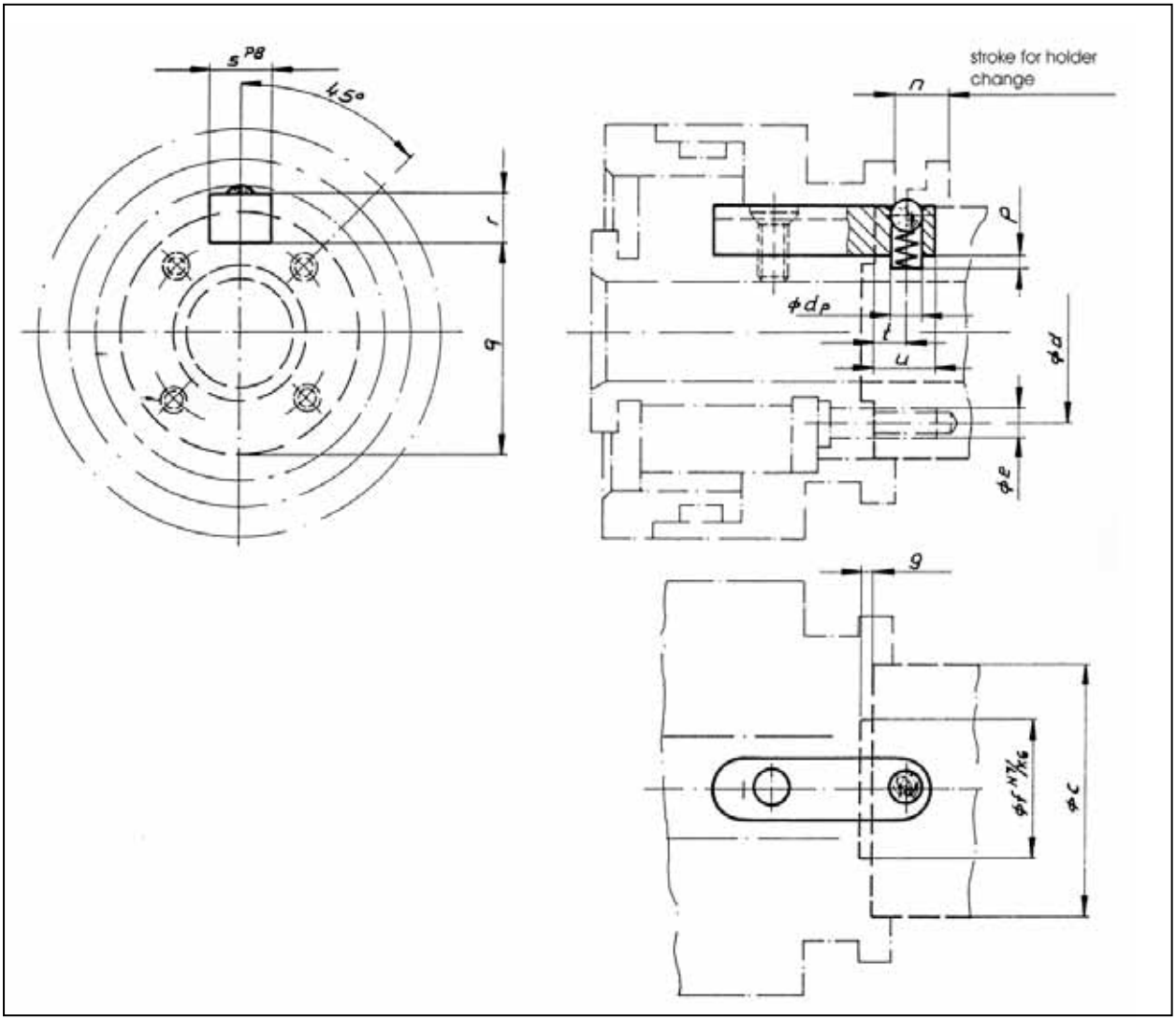
Einstellvorrichtung Fig. 3
setting device
dispositif de réglage
dispositivo de ajuste
congegno di registraziono



Strehlerschleifvorrichtung Fig. 4
chaser grinding fixture
dispositif d'affûtage de peignes
dispositivo de afilar peines
attrezzo per l'affilatura dei pettini



6.2. Mounting of die heads ZR 27-2



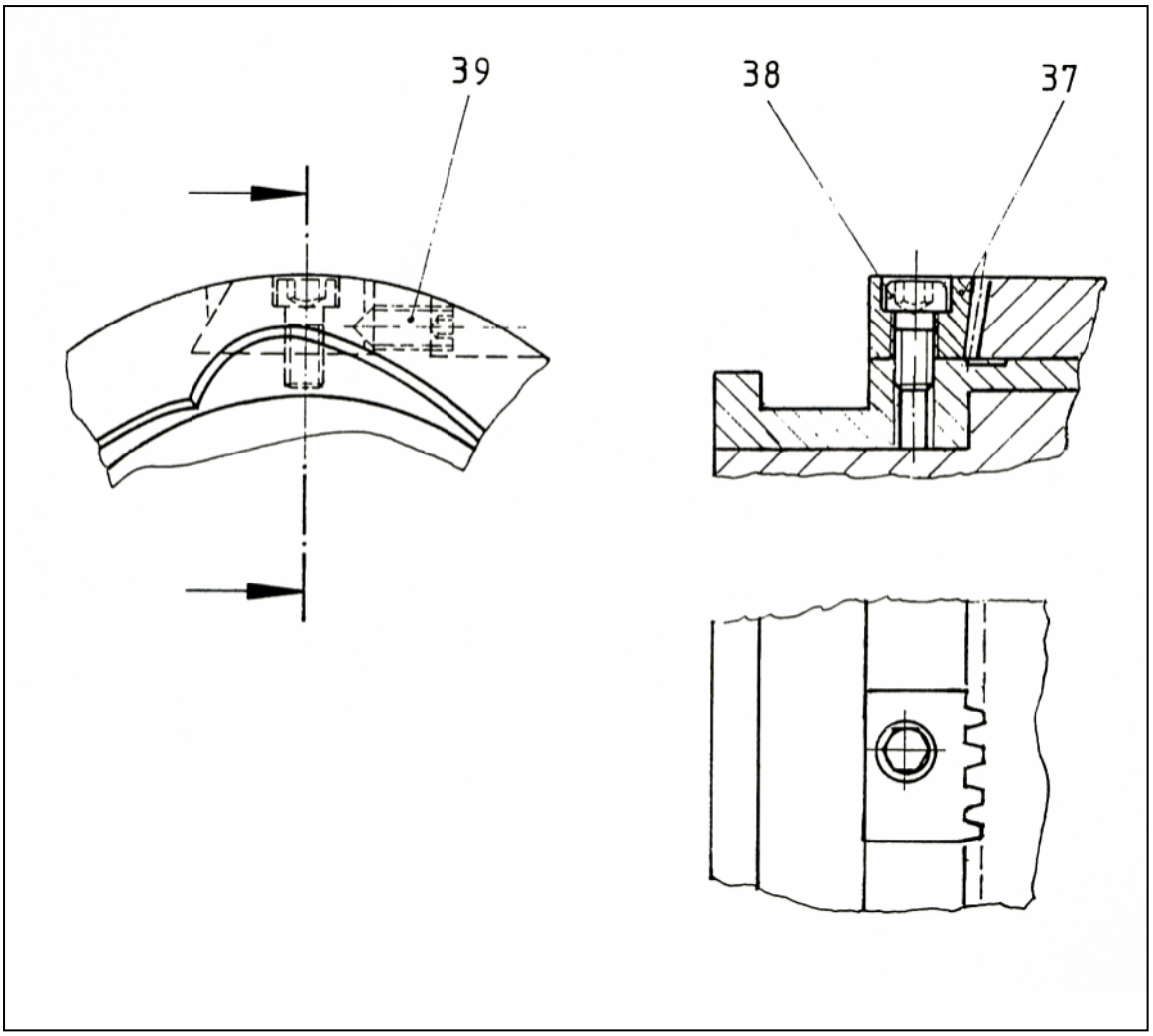
The spring-loaded ball catch prevents the head from opening on account of vibrations (especially when cutting brass).

When drilling the bore d_p on the spindle, do not drill through the bore in the sliding key.

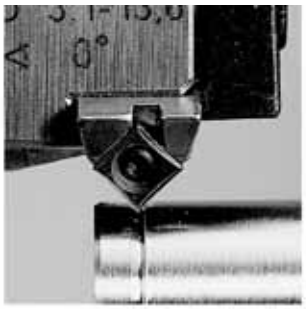
Type	Dimensions													
	c	d	d_p	e	f	g	n	p	q	r	s	t	u	Ball-Ø
ZR27	60	47	8	6.4	35	3.2	18	4	54	9	14	$6.25^{+0.2}$	14	7.5

Screws for fixture: M6x25

6.3. Single Parts for the die head with special detent ZR 27-AR



No.	Quantity	Product no.	Designation
37	1	73801600	Toothed segment (set = 20 pieces)
38	1	73560000	Cheese head
39	1		Thread pin



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FLOYD

01462 491919
sales@floydautomatic.co.uk
www.floydautomatic.co.uk